

Landsat

Program Update

L A N D S A T
*Providing space-based observations of
 Earth since 1972*

July 23, 2002 was the 30th anniversary of the launch of the first of a series of Landsat satellites that have continuously supplied the world with global land surface images. Landsat 5, launched in 1984, continues to provide important observations of the landmass of the planet, and has established a record for reliability in the civilian satellite fleet. Landsat 7 joined Landsat 5 in April 1999. Both Landsat 5 and Landsat 7 provide data for remote sensing and GIS science and applications around the world.

For four years, the two earth observing satellites provided extensive, regular coverage. In late May 2003, Landsat 7's Enhanced Thematic Mapper Plus (ETM+), suffered the loss of its scan line corrector (SLC) mechanism. By mid-July 2003 the ETM+ resumed its global land survey mission resulting in only a six-week gap of imagery in the U.S. archive. However, the malfunction has had an impact on the imagery from Landsat 7.

The ETM+ optics contain the Scan Mirror and Scan Line Correction Assembly among other components. The Scan Mirror provides the across track motion for the imaging, while the forward velocity of the spacecraft provides the along track motion. The Scan Line Corrector (SLC) is used to remove the 'zig-zag' motion of the imaging field of view produced by the combination of the along and across track motion. Without an operating SLC, the ETM+ line of sight now traces a zig-zag pattern across the satellite ground track (Fig. 1).

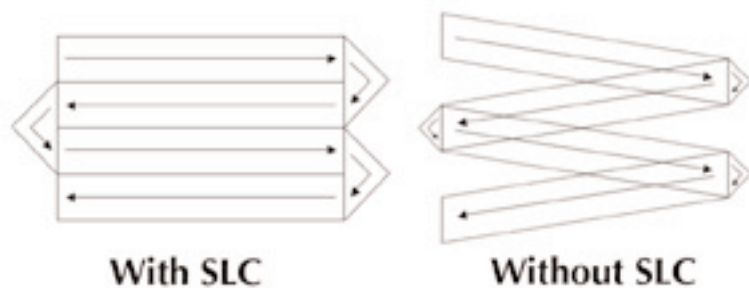


Fig. 1

In this SLC-off mode, the ETM+ still acquires approximately 75 percent of the data for any given scene. The gaps in data form alternating wedges that increase in width from the center to the edge of a scene (Fig. 2).

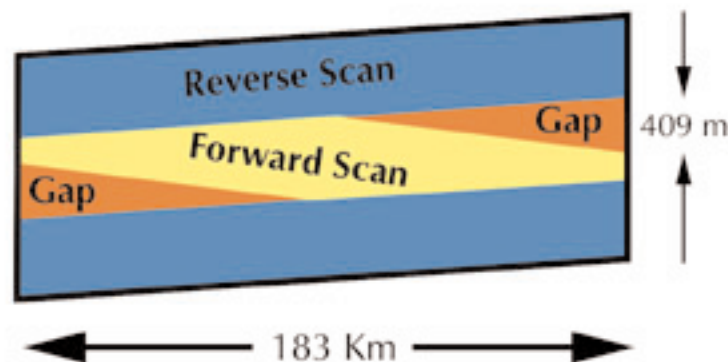


Fig. 2

The remainder of the ETM+ sensor, including the scanning mirror, continues to operate, radiometrically and geometrically, at the same high-level of accuracy and precision as it did before the anomaly; therefore, image pixels are still accurately geolocated and calibrated.

The Landsat 7 ETM+ system continues to produce high-quality data of the Earth's land areas.

To fulfill the expectations of the user community for full coverage single scenes, data from multiple acquisitions are being merged to resolve the SLC-off data gaps. The first of these gap-filled products was released from the USGS EROS Data Center in May 2004. In this SLC-off to SLC-on product, the gaps in a current SLC-off scene are filled with data from an SLC-on scene that was acquired approximately one year earlier (i.e., during the same plant phenological stage). The two scenes are geometrically registered, and a histogram matching technique is applied to the fill pixels that provide the best-expected radiance values for the missing data.

In late 2004, a SLC-off to SLC-off product was released. This more sophisticated product merges data from up to four SLC-off scenes acquired within weeks of each other, giving the new product a distinct temporal advantage. In all cases, a binary bit mask is provided so that the user can determine where the data for any given pixel originated.

The data-merge products represent an effort by the USGS Landsat 7 Project to increase the utility of the Landsat 7 data affected by the non-functional scan line corrector. The USGS continues to research new data-merge products and will provide resulting information as it becomes available.



Fig. 3 Example of an SLC-off to SLC-off data product. This figure contrasts a small portion of a Landsat 7 scene featuring Folsom Lake, California (WRS-2 Path 43 Row 33). The left image was acquired on August 12, 2003; the image on the right is the resulting gap-filled product using the August 28, 2003 acquisition to fill the gaps.

Further information and product samples of Landsat 7 slc-off data products can be found at the following website:
http://landsat.usgs.gov/slc_off.html

For information on all Landsat data products, visit the Landsat Data Products Web Page at <http://landsat.usgs.gov/dataproduct.php>

The Future of Landsat

Efforts to begin implementing a successor mission to Landsat 7, called the Landsat Data Continuity Mission (LDCM), suffered a set back in 2003. Landsat Program Management (NASA and USGS) had planned to purchase data meeting LDCM specifications from a privately owned and commercially operated satellite system beginning in March 2007. However, after an evaluation of proposals received from private industry, NASA cancelled a Request-for-Proposals (RFP) for providing the required data.

The RFP was cancelled in September 2003. Soon after, the Executive Office of the President formed an interagency working group to discuss Landsat data continuity in light of the cancellation. A memorandum from the Office of Science and Technology Policy (OSTP), signed on August 13, 2004 by the Director of OSTP, Dr. John Marburger, III, summarizes the outcome of these discussions. The memorandum states that “the Departments of Defense, the Interior, and Commerce and the National Aeronautics and Space Administration have agreed to take the following actions:

- “Transition Landsat measurements to an operational environment through the incorporation of Landsat-type sensors on the National Polar-orbiting Operational Environmental Satellite System (NPOESS) platform;
- “Plan to incorporate a Landsat imager on the first NPOESS spacecraft (known as C-1), currently scheduled for launch in late 2009;

- “Further assess options to mitigate the risks to data continuity prior to the first NPOESS-Landsat mission, including a ‘bridge’ mission.”

The Departments of Defense, the Interior, Commerce and NASA are now working towards implementing these actions through the normal budget process. A copy of the OSTP memorandum can be found at the NASA LDCM web site: <http://ldcm.nasa.gov>.

30+ Years of Landsat Data available through USGS

To search for data, please visit the EarthExplorer or GloVis website:

EarthExplorer <http://earthexplorer.usgs.gov>

GloVis <http://glovis.usgs.gov>

Data no longer available at the EOSDIS Gateway

Although the method of data access has changed, there are no other changes to the processing or format of the products. Level 1 and Level 0 products that were available through the EDG are now orderable through the USGS Earth Explorer and the Global Visualization Viewer (GloVis). As before, data processing is done by the LPGS and NLAPS systems.

Data Pricing

Landsat 5 data cost \$425 per scene (for Level 1G processing). Landsat 7 data acquired prior to the SLC malfunction cost \$600 per scene (for Level 1G processing).

The USGS has reduced the price of Landsat 7 scenes with gaps in data resulting from the SLC failure. Scenes that contain gaps in data have been reduced from \$600 to \$250.

SLC-off to SLC-on data products are offered at the reduced price of \$275 as of May 10, 2004. This product has the gap areas filled in with Landsat 7 data acquired prior to the SLC failure at a similar time of the year.

SLC-off to SLC-off products, i.e., scenes with the gaps filled using multiple SLC-off images, are available for \$300.

The Landsat Project is a joint initiative of the National Aeronautics and Space Administration (NASA) and the U.S. Geological Survey (USGS) to gather Earth resource data using a series of satellites. NASA was responsible for developing and launching the spacecrafts, whereas USGS is responsible for flight operations, maintenance, and management of all ground data reception, processing, archiving, product generation, and distribution.

